River otters in Prince William Sound and Kenai Fjords National Park:

Distribution, relative abundance, and minimum population size

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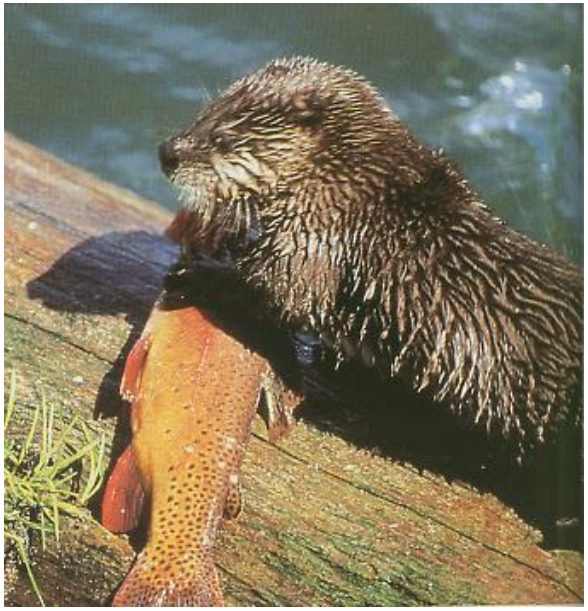
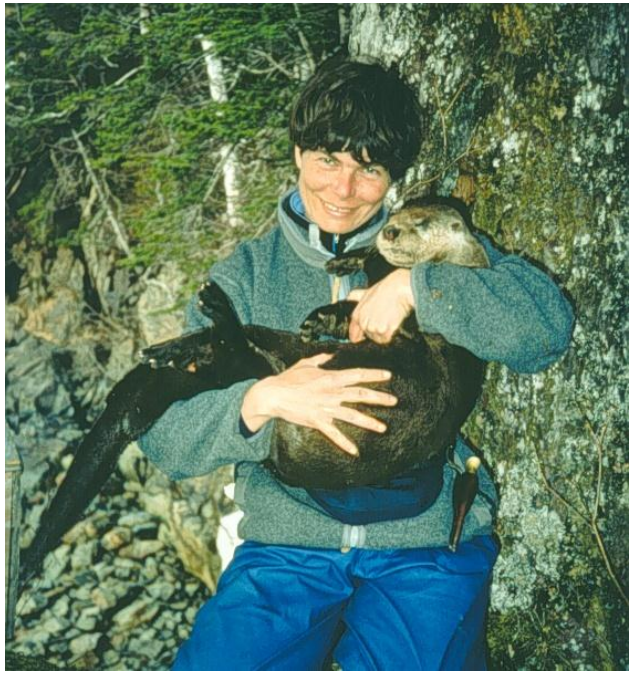
Financial and Logistical support:

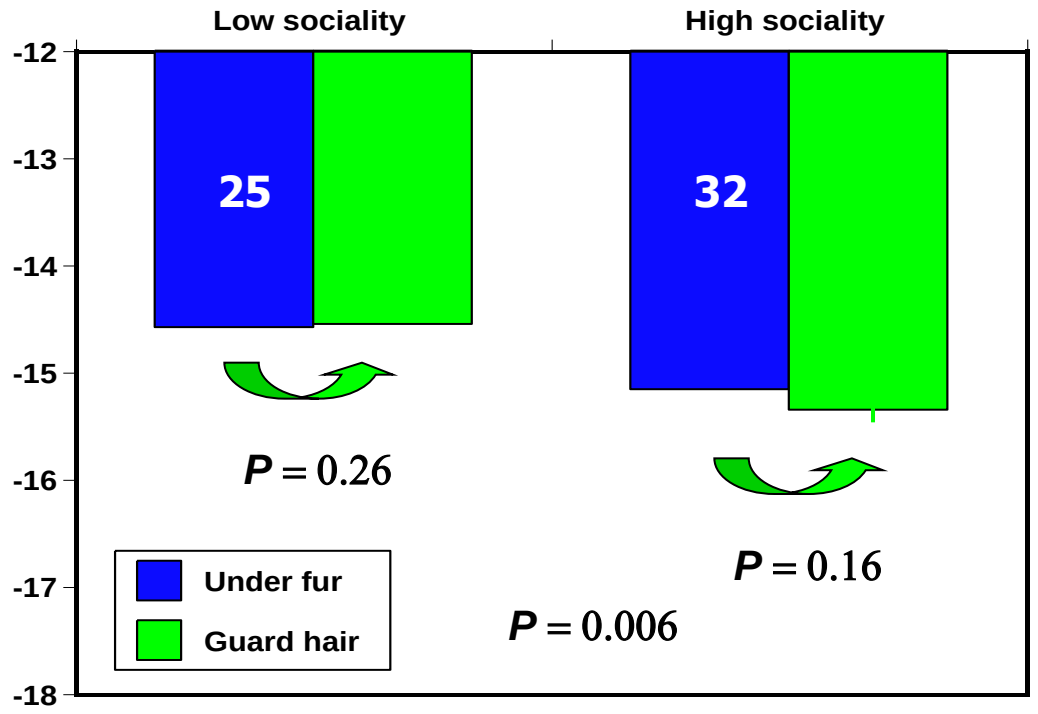
Alaska Department of Fish and Game
National Park Service - SWAN
Oil Spill Recovery Institute – Prince William Sound Science Center
University of Wyoming
US Forest Service

Why monitor river otters?



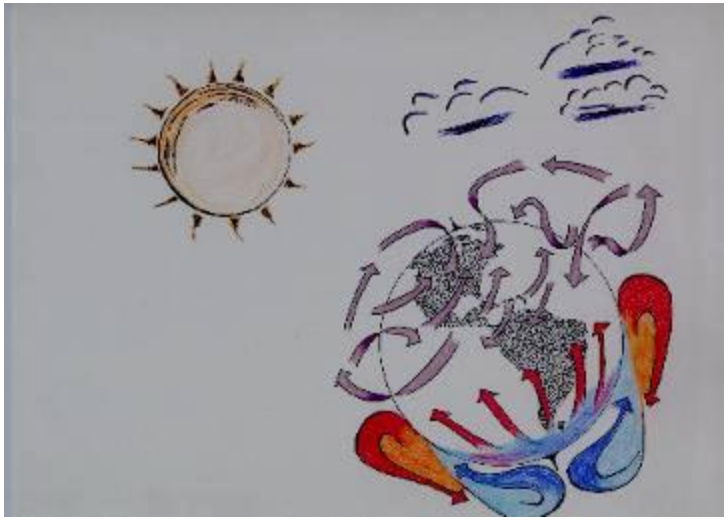


River otters are top fish predators in the nearshore environment

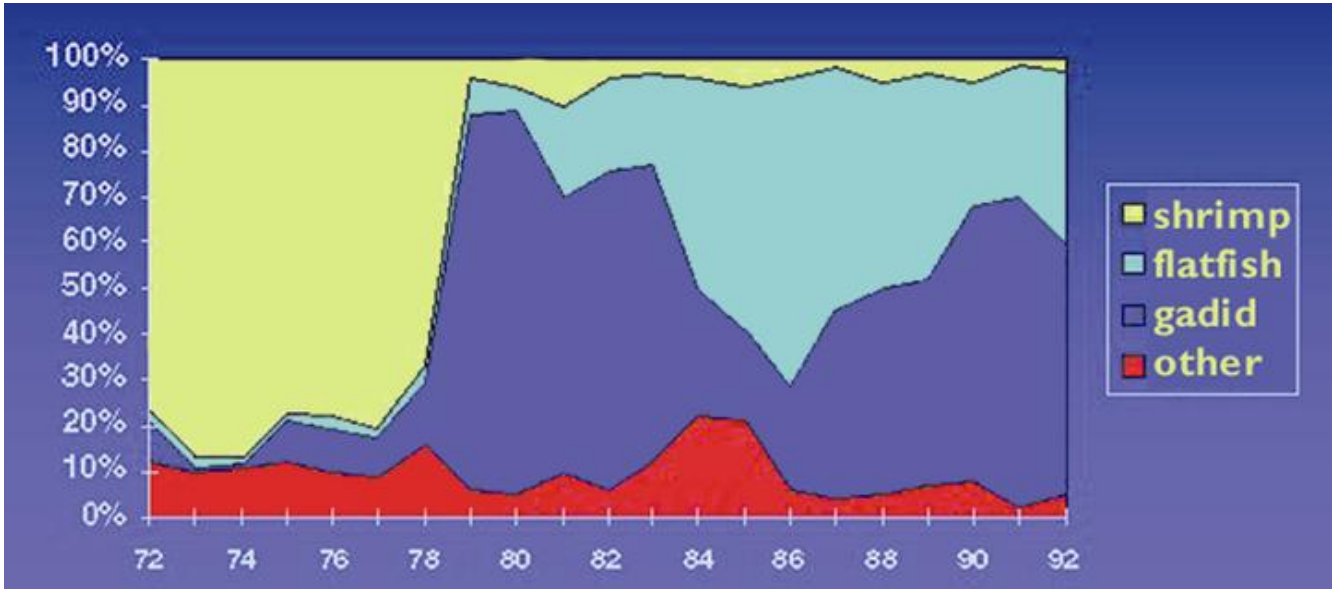


Adopted from Blundell et al. (2002)

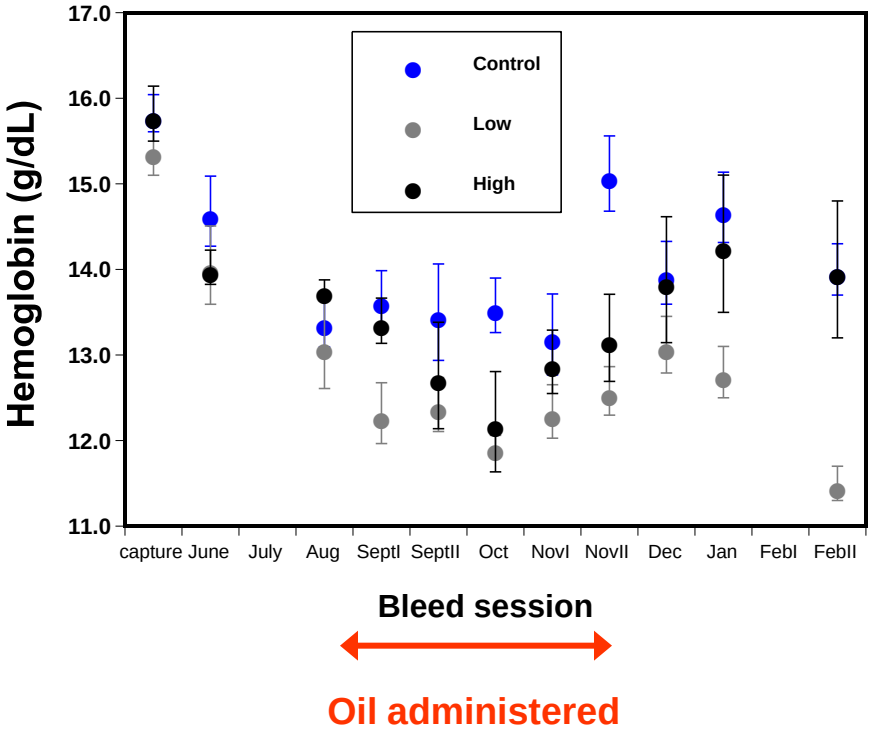
Otters can serve as sentinels for changes in the nearshore environment

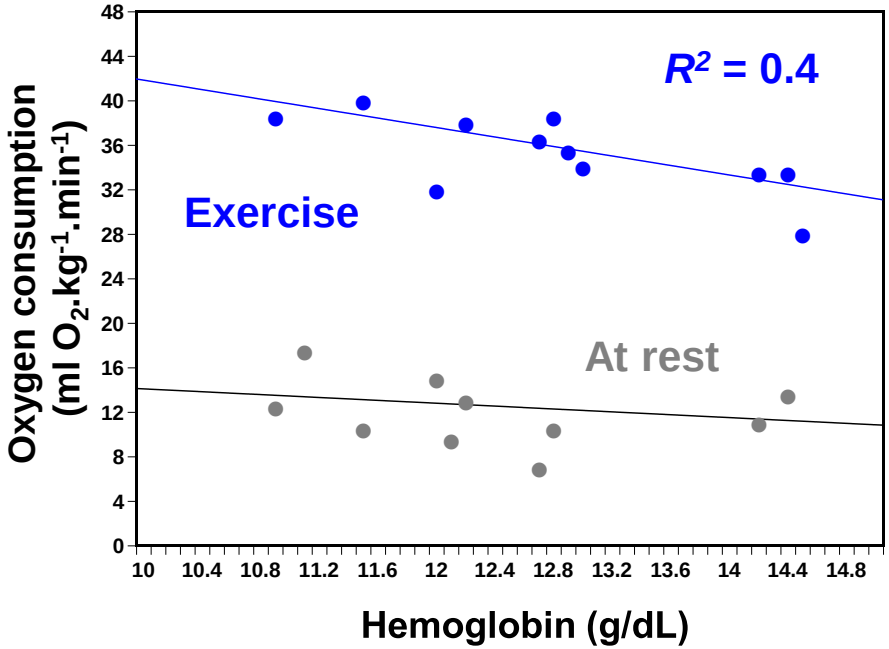


Regime shift in the gulf of Alaska
Adopted from Piatt and Anderson (1996)



River otters are sensitive to environmental pollution



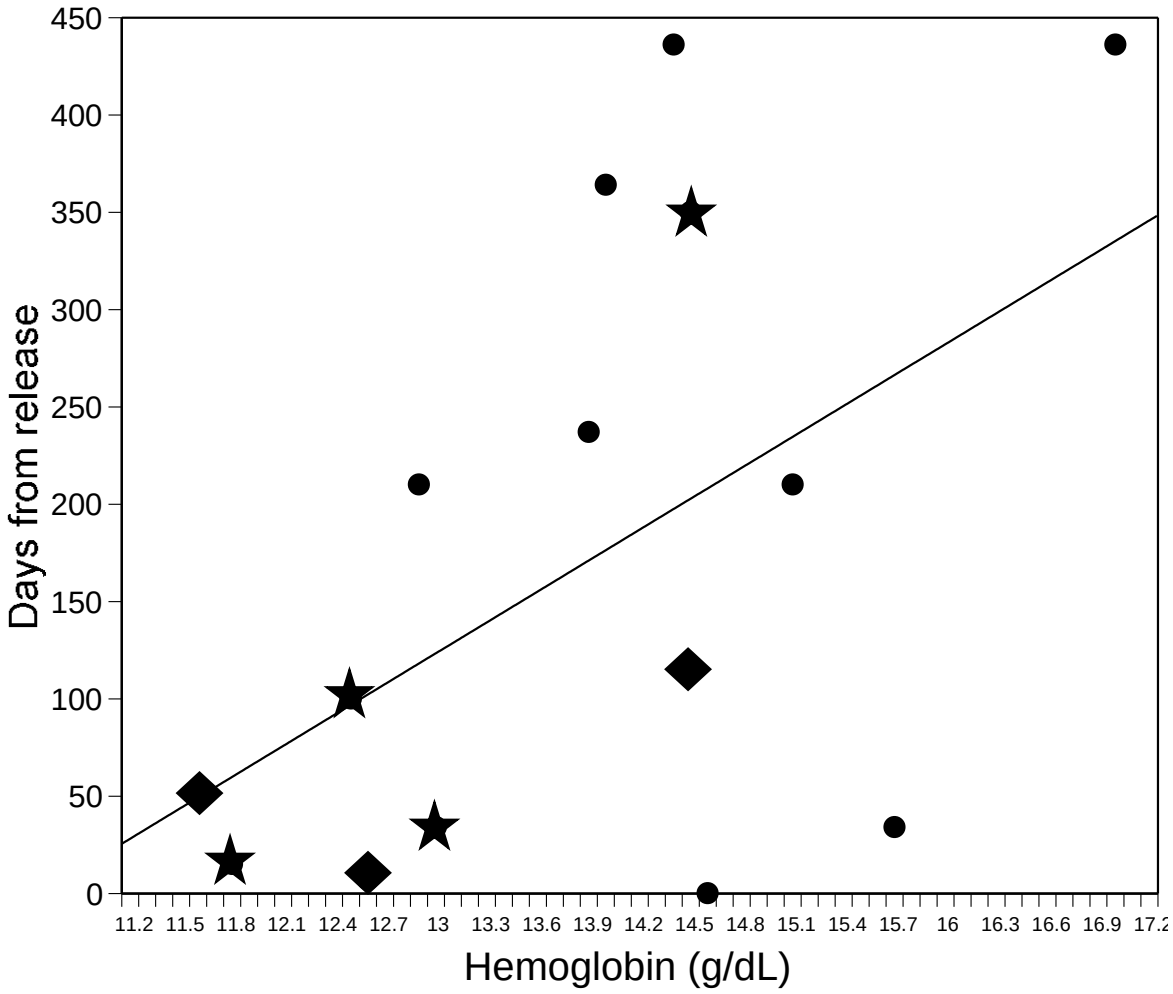


VO_2 = 61.10 - 2.01(Hb)
Results in a 37.6% increase in energetic cost of running in river otters with low hemoglobin levels

Ben-David et al. (2000)

Hemoglobin levels were positively related to post-release survival of captive (*n* = 15) river otters. (◆) represent missing animals; (★) represent animals dying of starvation. (Proportional hazard regression *P* = 0.045)

Ben-David et al. (2002)



River otter link the marine and terrestrial ecosystems

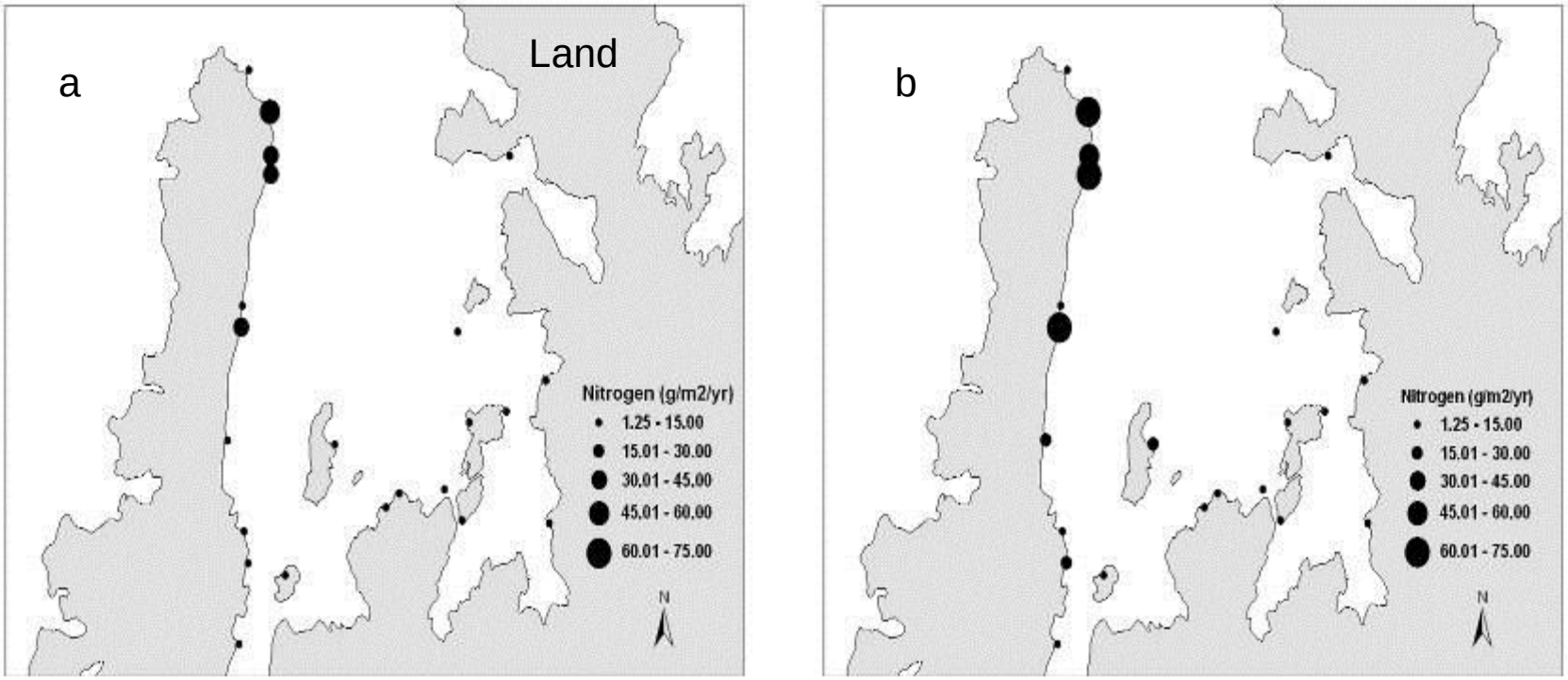
How much nitrogen can otters transfer from sea to land?

If otter densities are 1 per 1.3 km of shoreline deposition at latrines can be as high as 160 g/m^2/year

Atmospheric deposition in Alaska = 0.01-0.3 g/m^2/year

Ben-David et al. (*in press*)

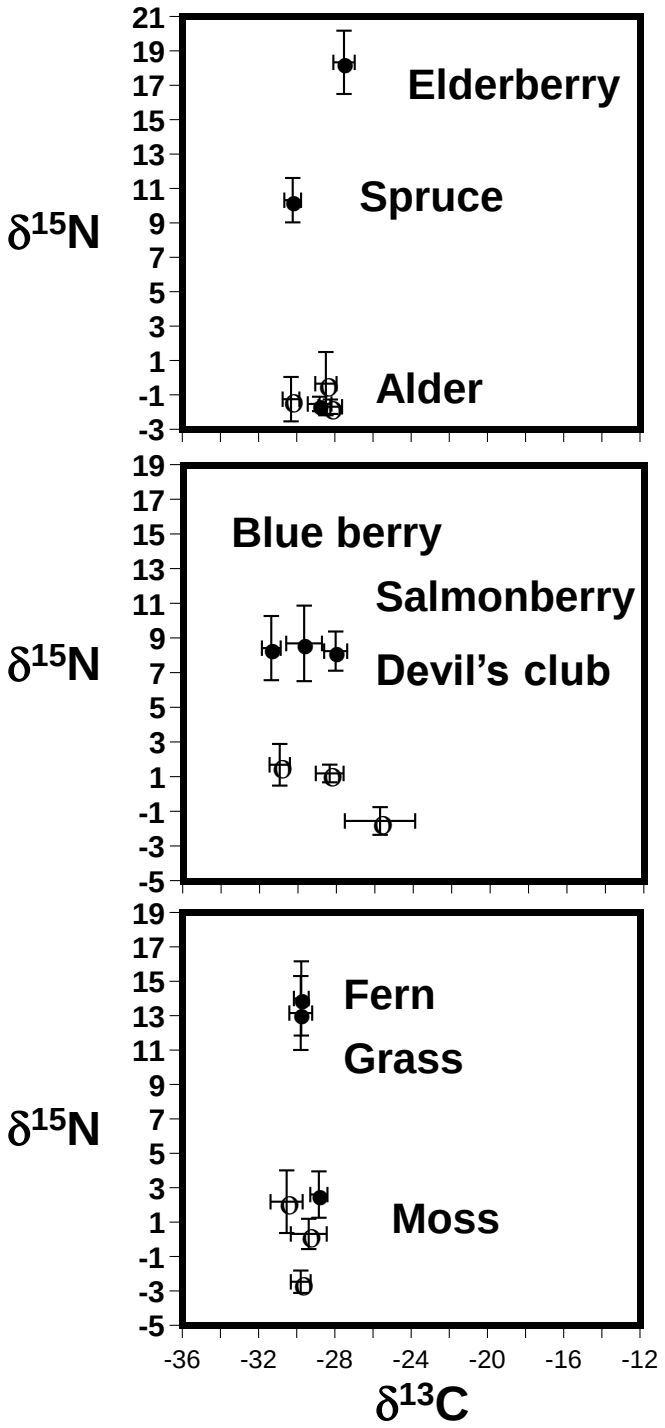
Nitrogen deposition at latrines in Herring Bay in g/m^2/year at different latrines based on actual visitation rate determined from radio-telemetry. (a) assuming group size of 4, (b) assuming group size of 7



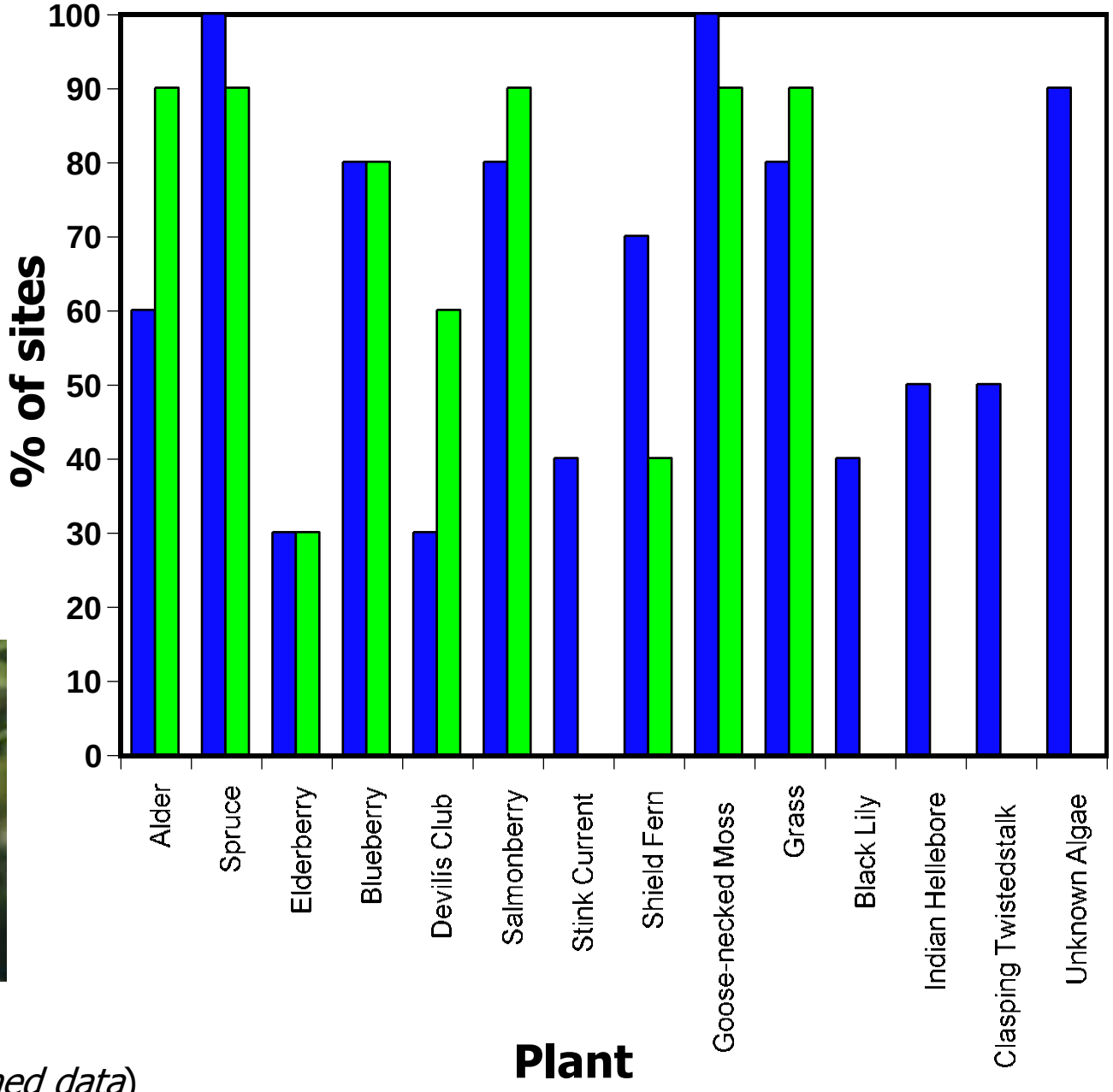
Ben-David et al. (*in press*)

Incorporation of marine derived nitrogen into terrestrial vegetation (*n* ranges between 4 and 12 samples per plant species; closed symbols represent plants growing on river otters latrine sites, open symbols plants growing at random sites)

Ben-David et al. (1998)

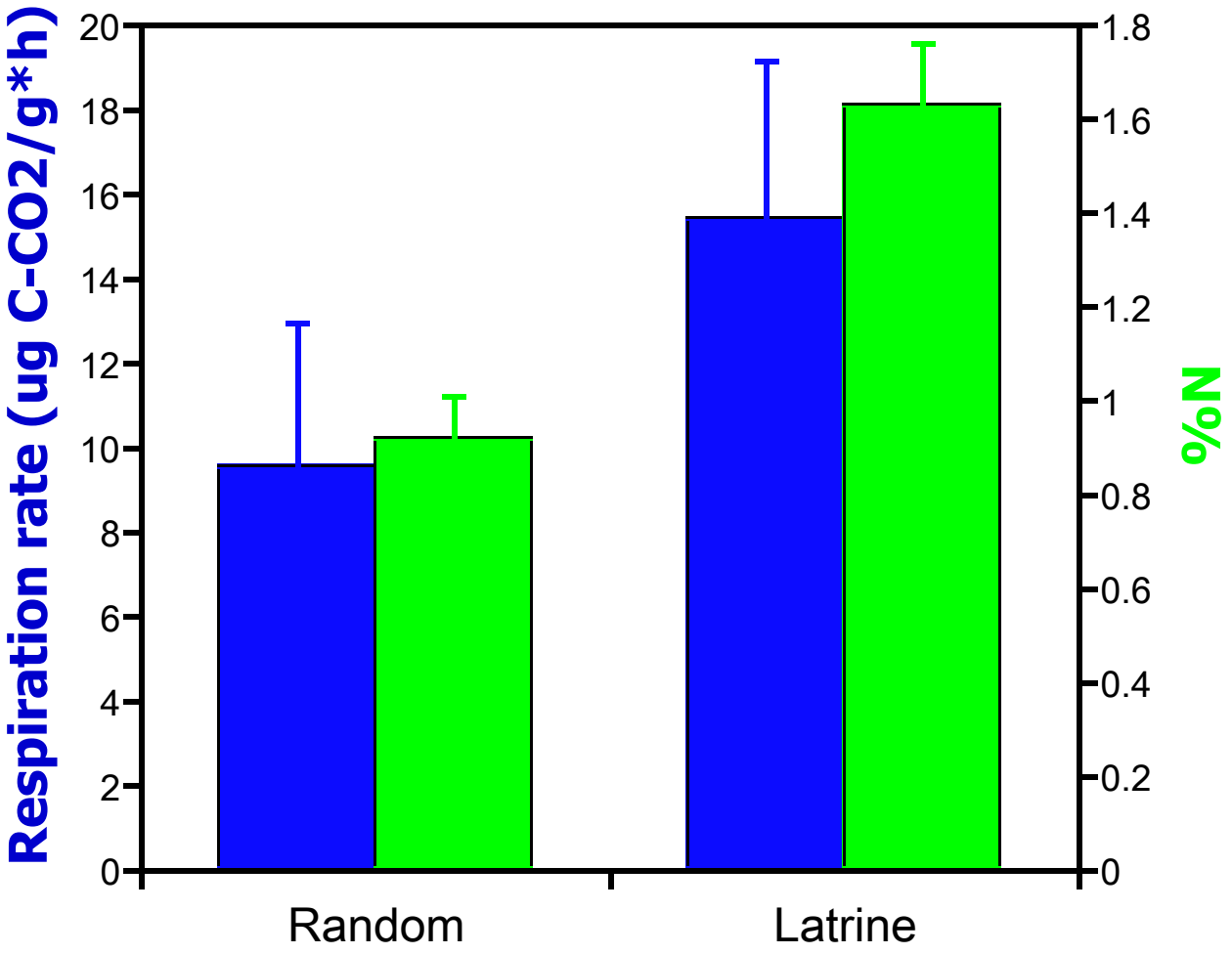


Differences in community composition of plants between river otter latrines (n = 12) and nonlatrines (n = 9)



Ben-David (*unpublished data*)

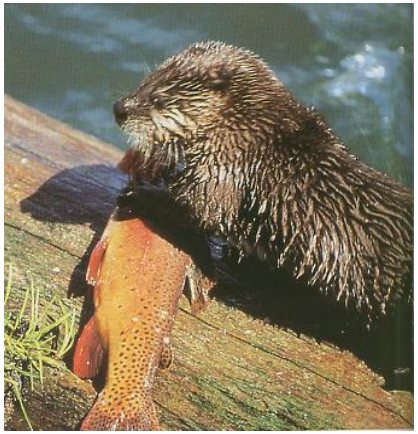
Differences in percent N in soil and soil respiration rate between river otter latrines (n = 5) and nonlatrines (n = 3)

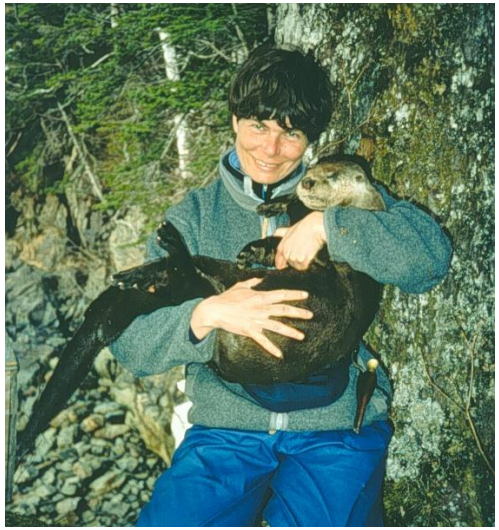


Ben-David and Gulledge (*unpublished data*)

How to monitor river otters?

They are hard to observe and difficult to re-capture





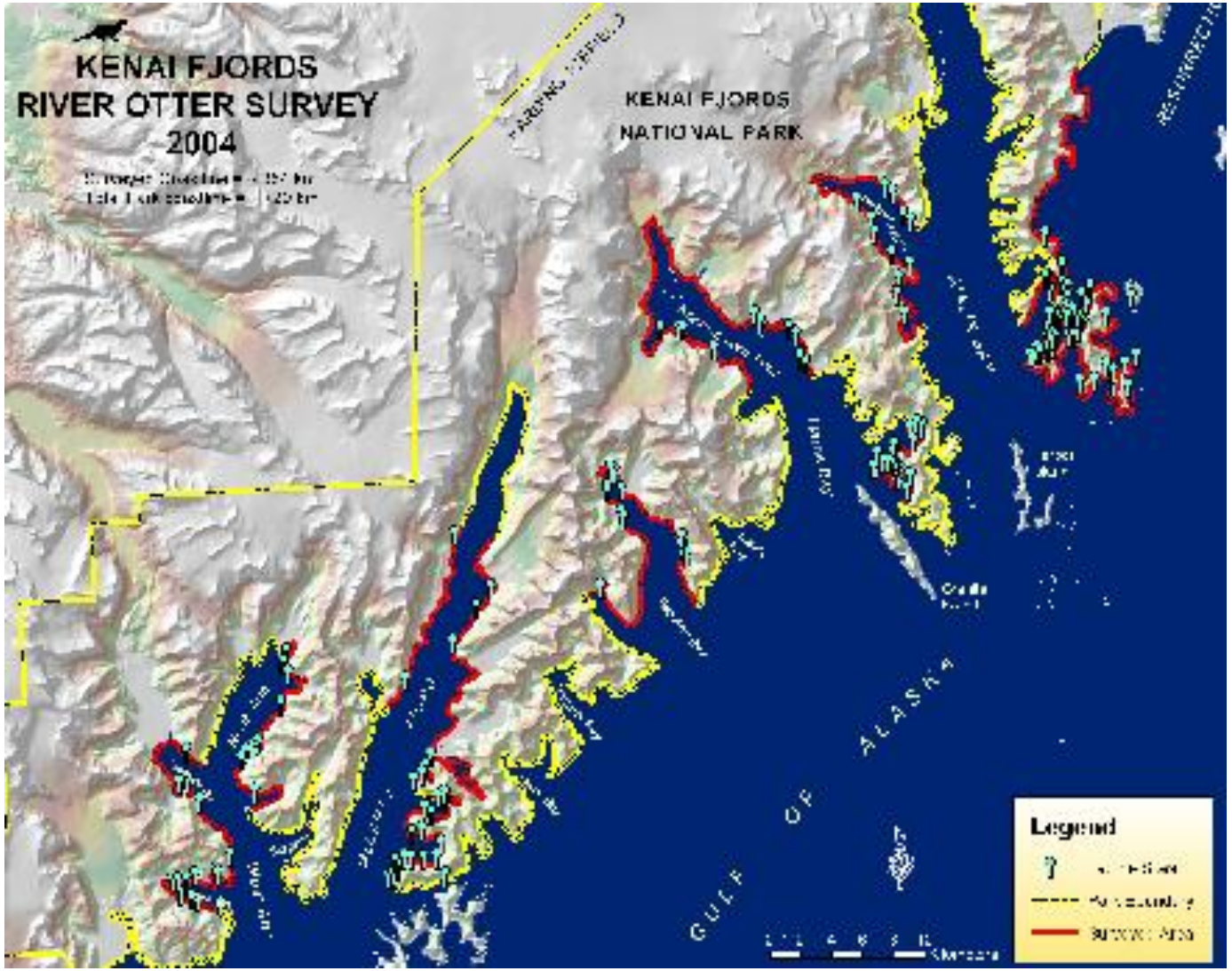
Distribution and relative abundance:

Latrine site surveys

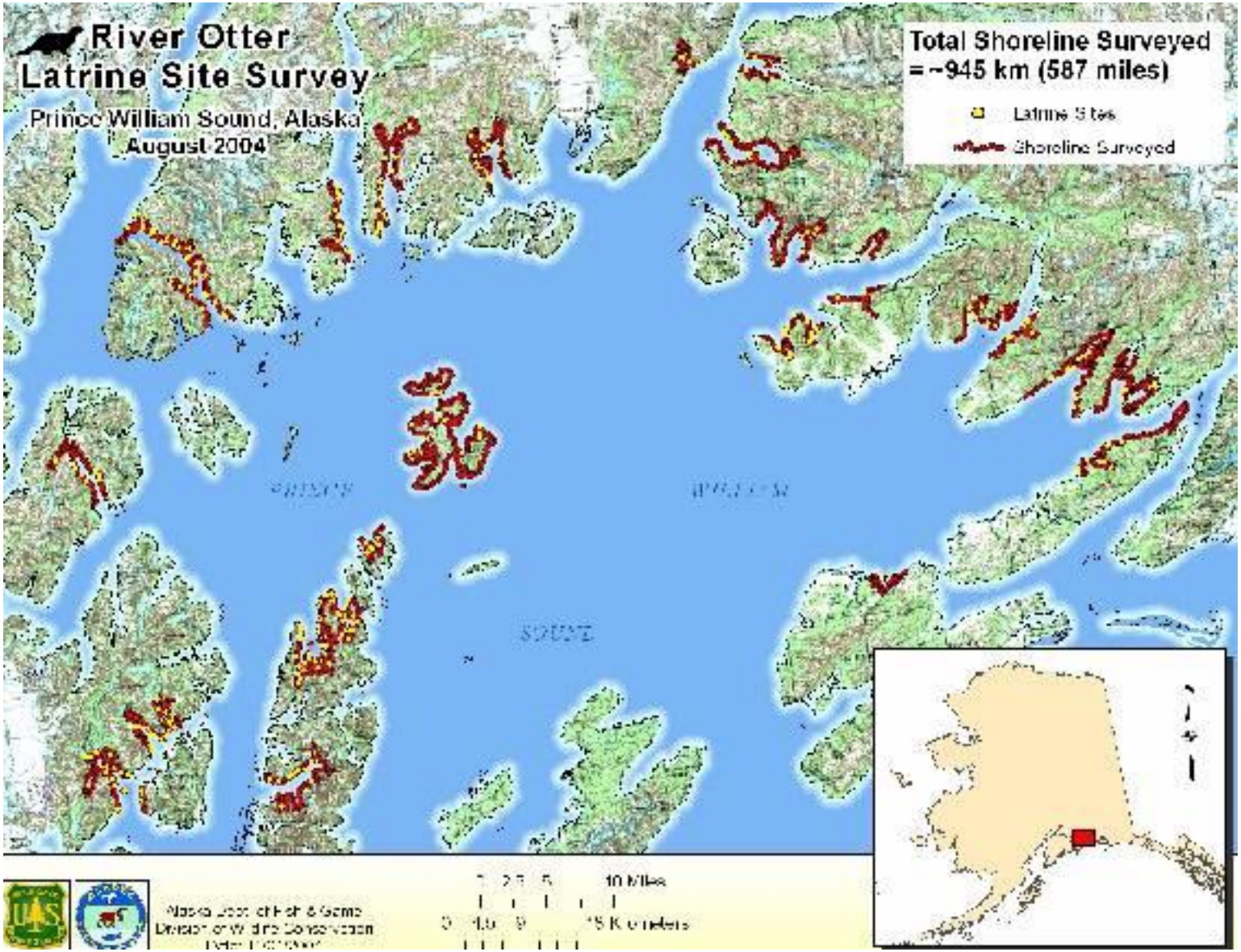
a. latrine density
b. fecal deposition rate
c. habitat selection

Location	Dates	Length of shoreline (km)	Latrine density	Fecal deposition rate
Kenai Fjords NP	7/5-10/04	354	0.432	1.94
Prince William Sound	8/9-21/04	945	0.269	1.80

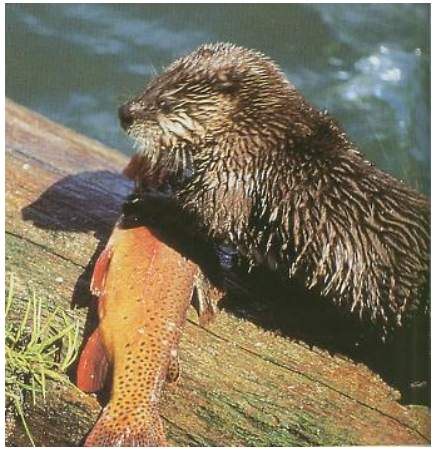
Distribution of river otter latrine sites in Kenai Fjords National Park as determined during a survey in July 2004

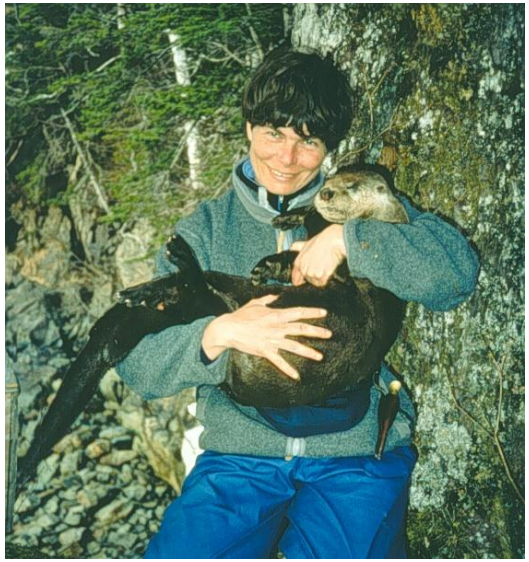


Distribution of river otter latrine sites in Prince William Sound as determined during a survey in August 2004

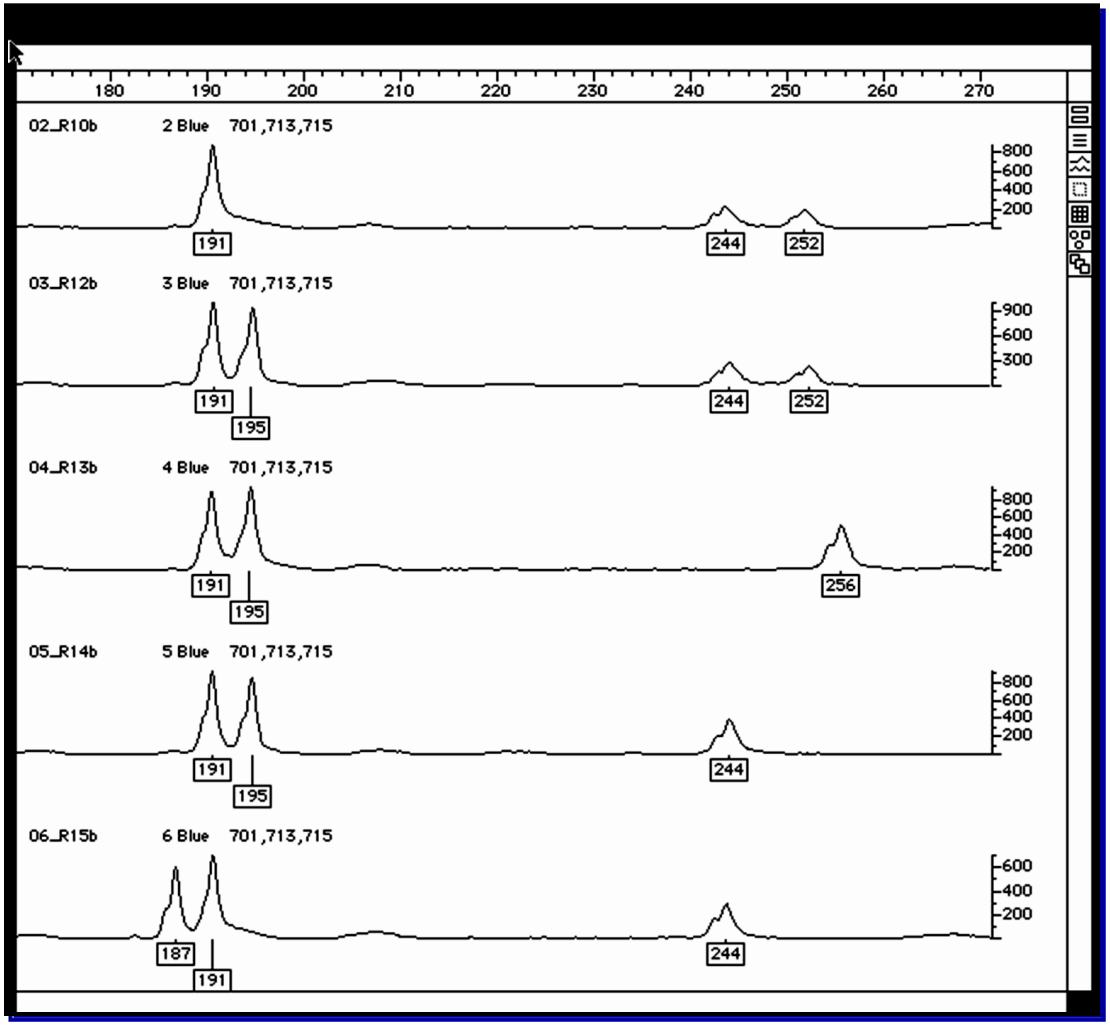


Are "latrine density" and "fecal deposition rate" accurate indices of river otter abundance/density?





Identifying individuals from ‘DNA Fingerprints’ of nuclear microsatellites in feces



LOCUS 1 LOCUS 2

Estimating population size with mark-recapture methods of individuals identified from feces:

Latrine site surveys

a. collect all fresh feces (< 12 hours old) on first visit (marking occasion)
b. collect all fresh feces on second visit (re-capture occasion)
c. preserve all feces in 100% ethanol and keep cool

Extracting and amplifying otter DNA from feces

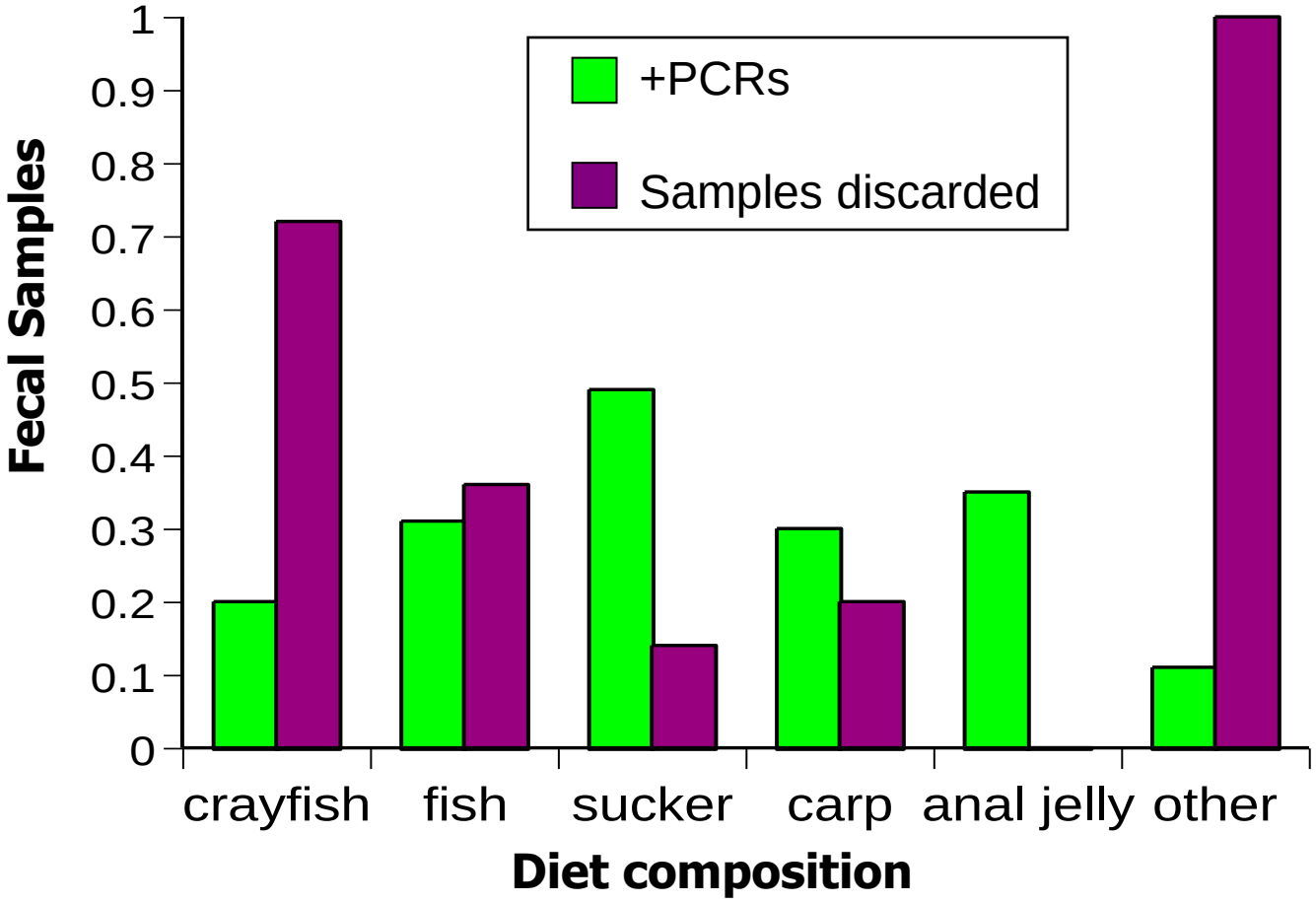
- Samples are sieved to remove prey remains
- Excess EtOH evaporated
- Extracted using Qiagen
- Prescreened with 2 best primers (Lut701, RIO05)
- Samples that do not amplify after 3 PCRs are discarded

Location	Number of fresh feces collected on first occasion	Number of fresh feces collected on second occasion	Total	Discarded
KEFJ	267	NA	267	166
PWS	302	263	565	377

Is this a low success rate?

Species	Location	Success rate
River otters	KEFJ (AK)	38%
	PWS (AK)	33%
	Green River (WY)	34%
Eurasian otters	Scotland (UK)	15%
Brown Bears	Captive (WA)	20%
All studies		31%

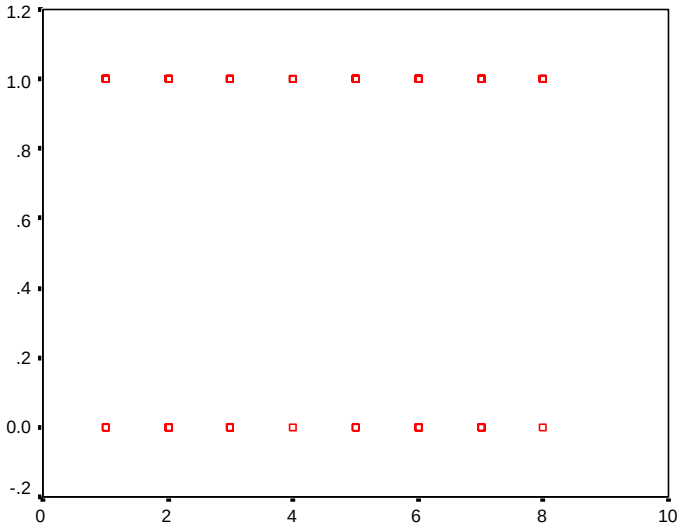
Effects of diet on genotyping success

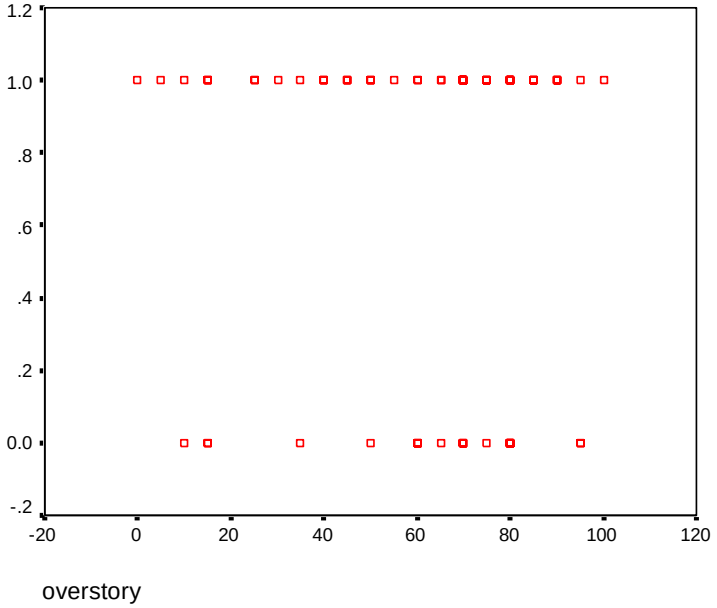


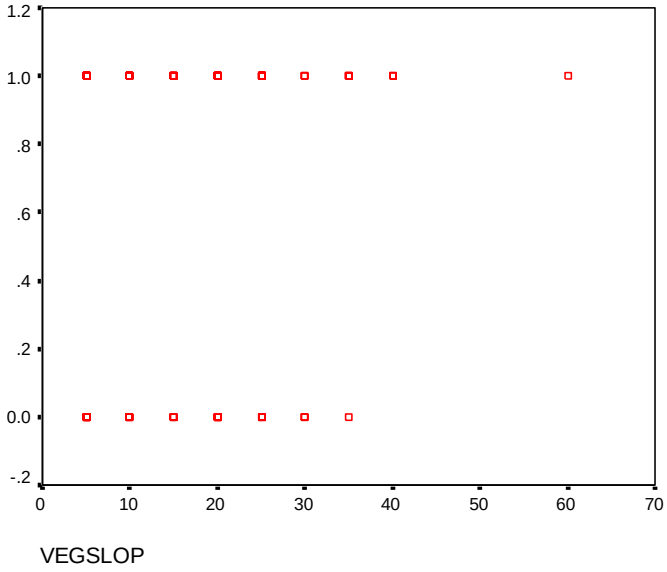
Hansen (2004); supported by a graduate fellowship from the Oil Spill Recovery Institute

Effects of habitat characteristics on genotyping success

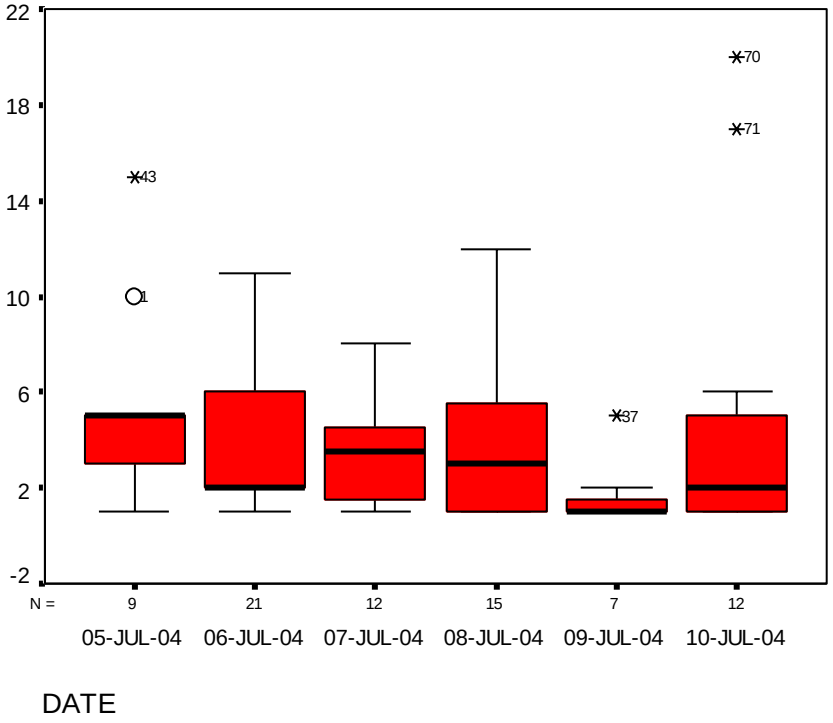
None of 12 habitat variables could explain differences in genotyping success (logistic regression with successful sites coded as 1 and unsuccessful sites coded 0)



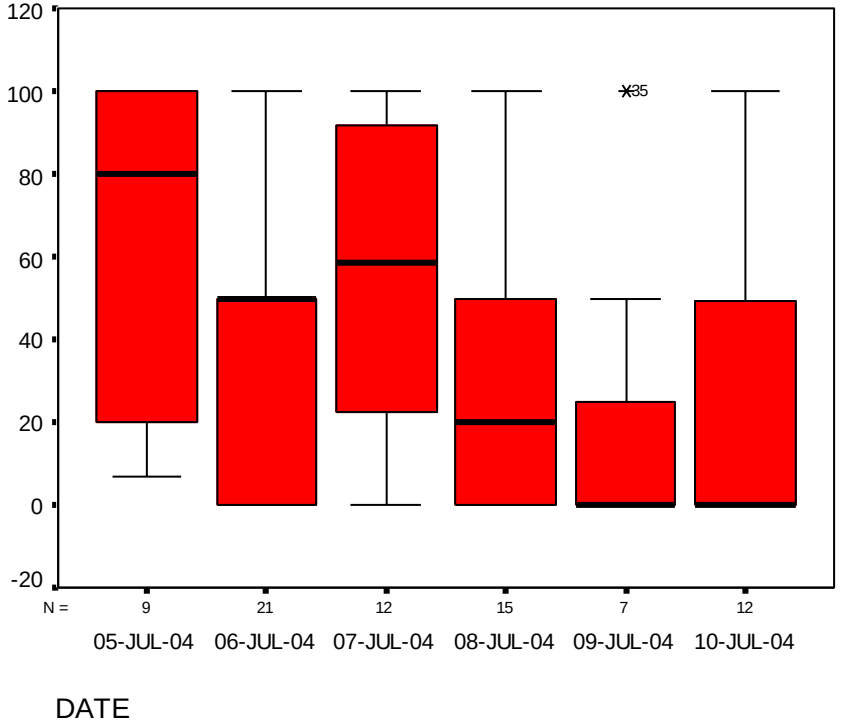




Effects of environmental conditions on genotyping success

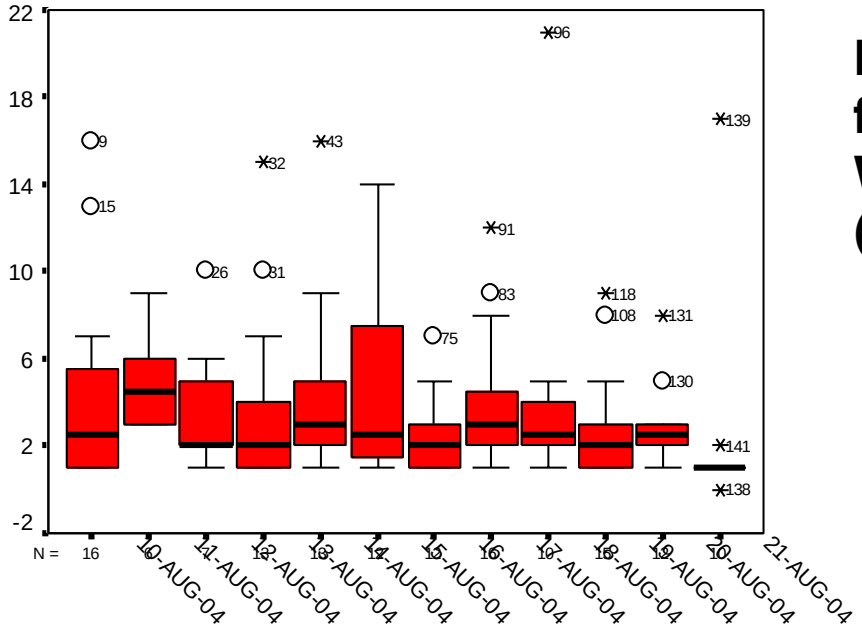


No difference in the number of feces collected per day in Kenai Fjords National Park in July 2004 (ANOVA, *P* = 0.38)

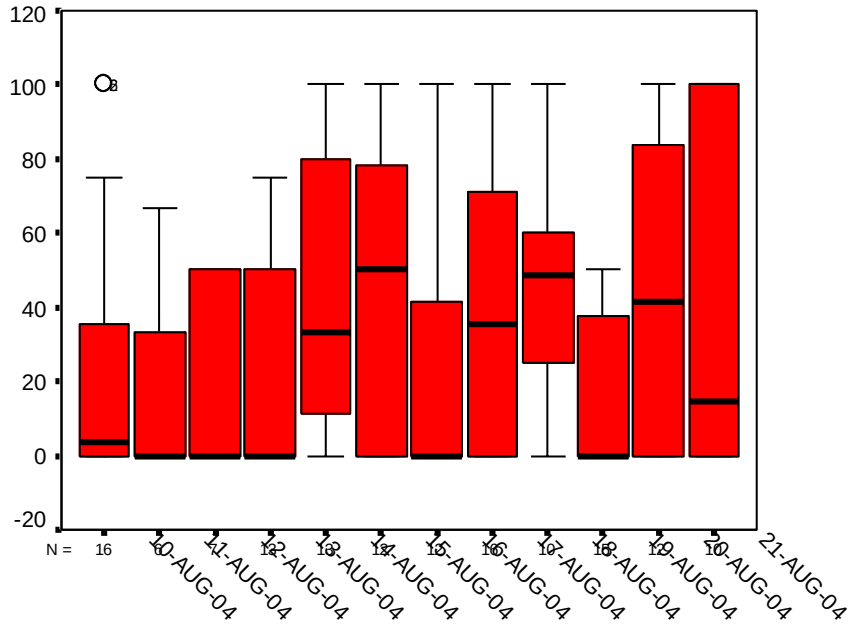


Significant reduction in genotyping success (percent success) per day in Kenai Fjords National Park in July 2004 (ANOVA, *P* = 0.009)

Effects of environmental conditions on genotyping success

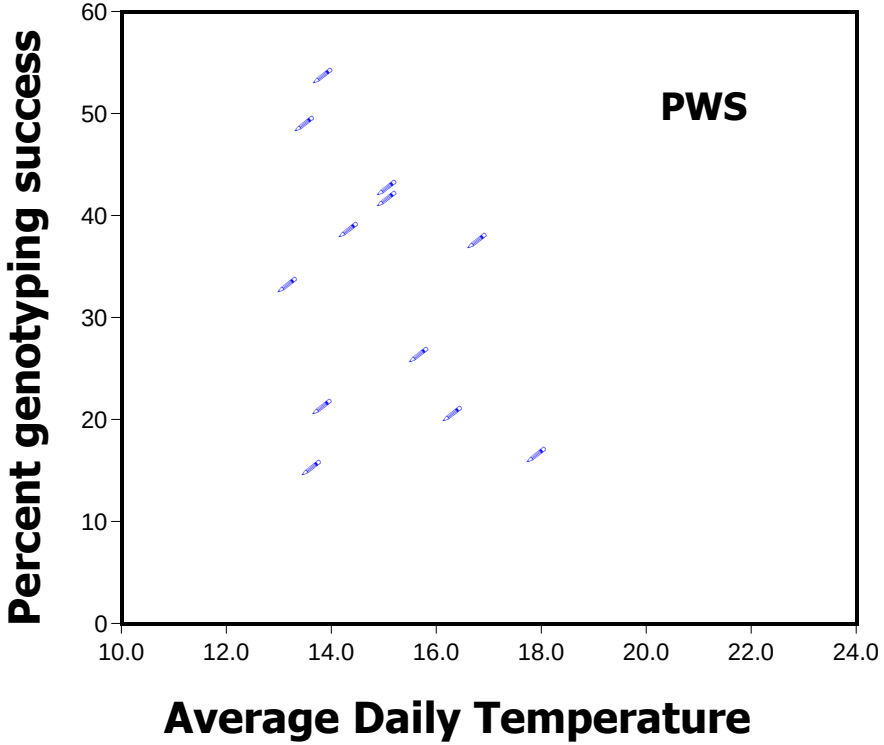


No difference in the number of feces collected per day in Prince William Sound in August 2004 (ANOVA, *P* = 0.86)



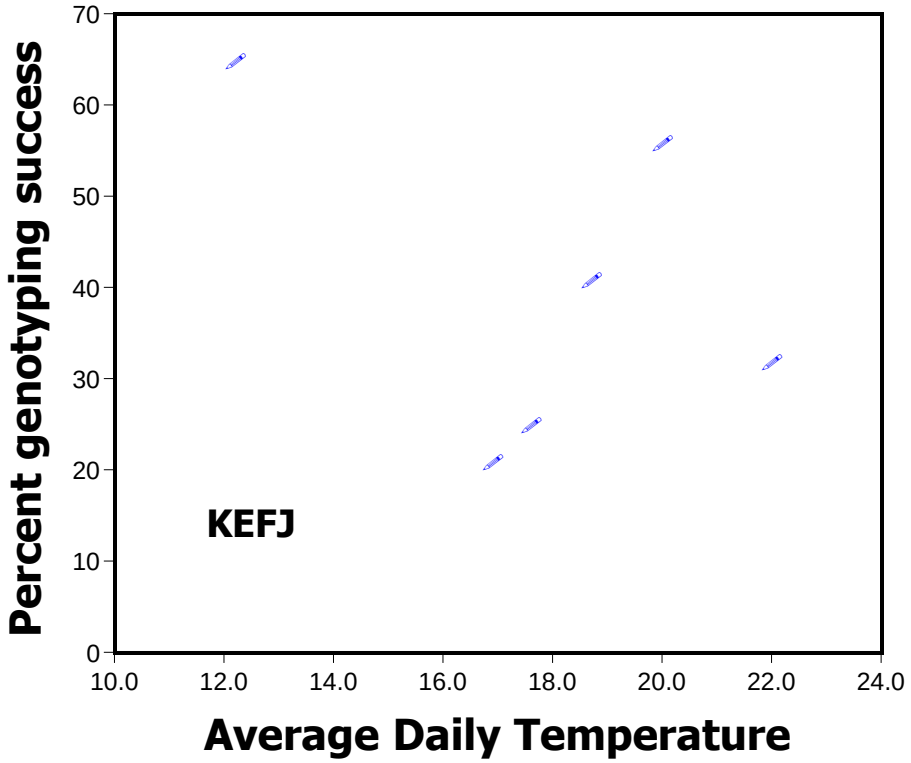
No difference in genotyping success (percent success) per day in Prince William Sound in August 2004 (ANOVA, *P* = 0.25)

Effects of environmental conditions on genotyping success

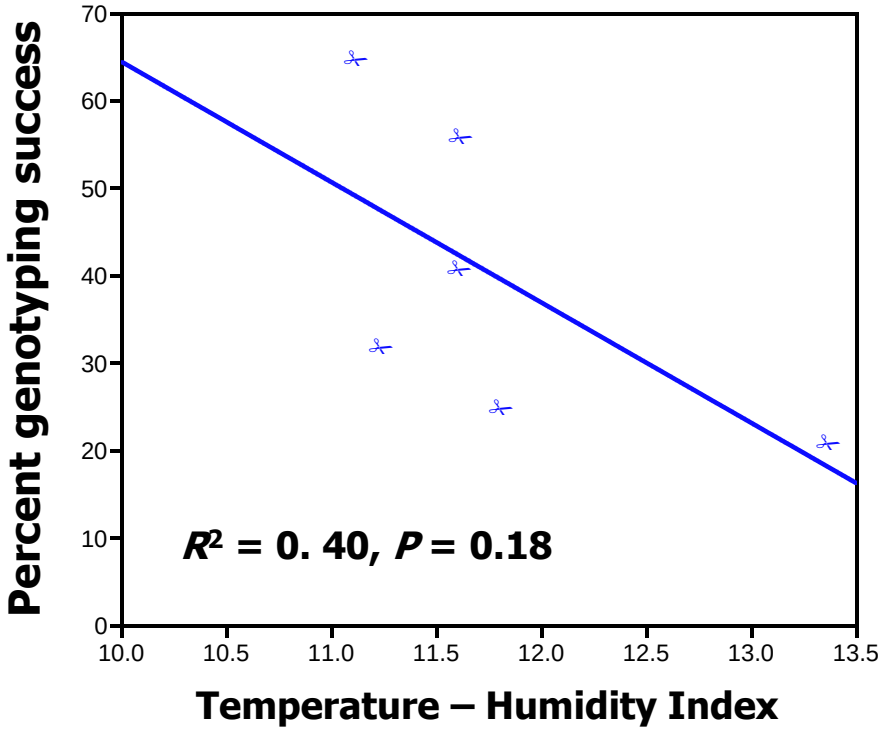


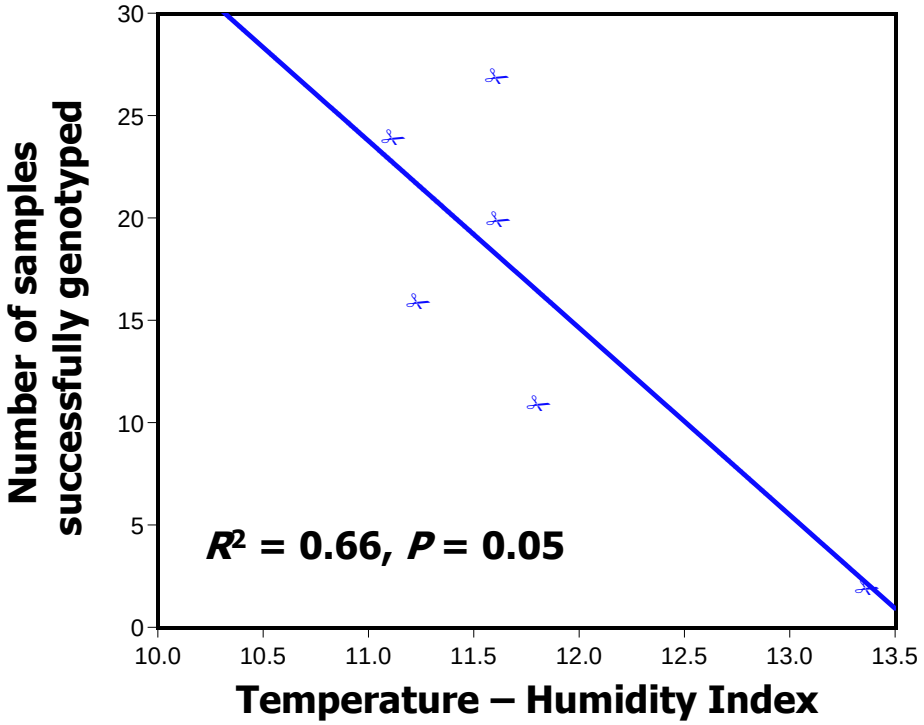
No effect of temperature alone on genotyping success in Prince William Sound in August 2004 (Regression, *P* = 0.27)

No effect of temperature alone on genotyping success in Kenai Fjords National Park in July 2004 (Regression, *P* = 0.41)



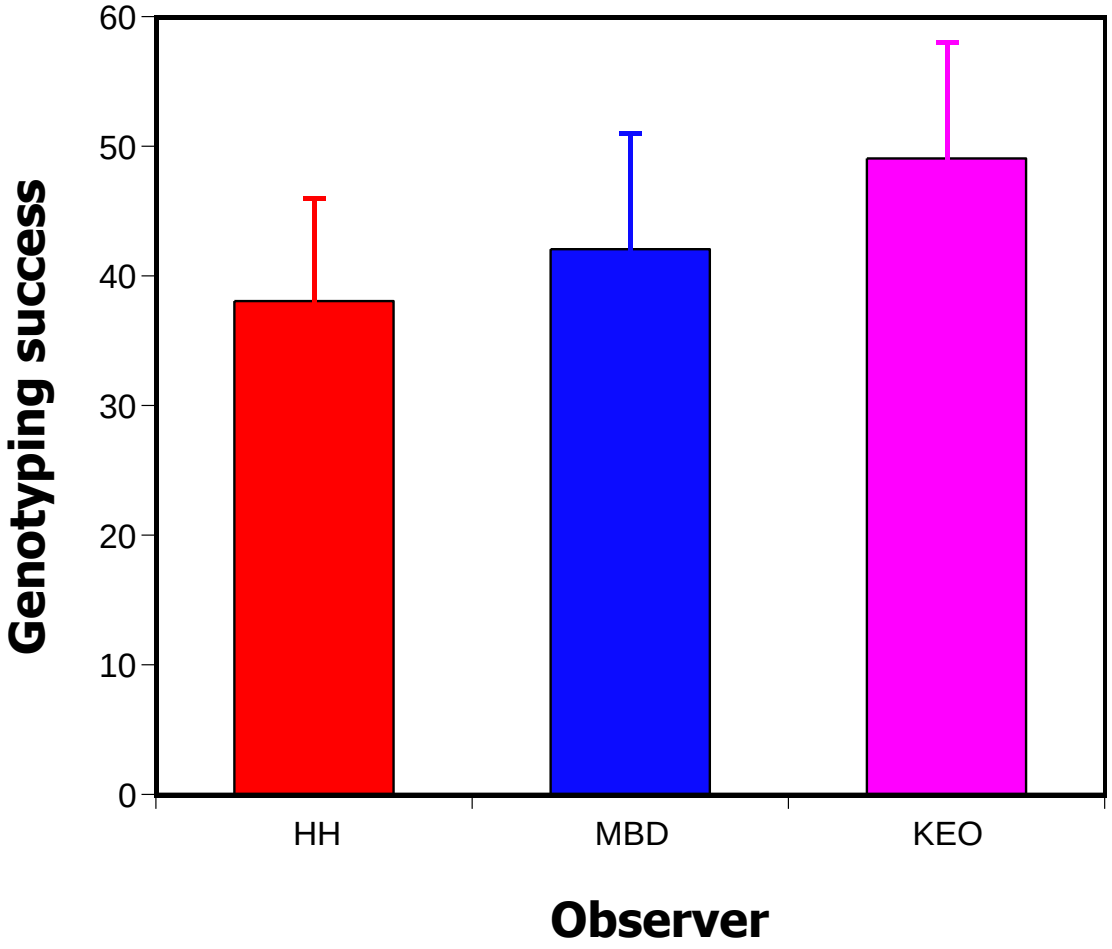
Effects of environmental conditions on genotyping success





Reduction in genotyping success with increasing temperature humidity index in Kenai Fjords National Park in July 2004 (Linear regression)

Observer bias? NO!



No difference in genotyping success of feces collected by different observers in Kenai Fjords National Park in July 2004 (ANOVA, *P* = 0.38)

Effects of intestinal parasites on genotyping success

Location	Prevalence of parasites	Percent of genotyping success in infested feces	Percent of genotyping success in non-infested feces
KEFJ	36%	19.8%	49.1%
PWS	10%	NA	NA

Future work:

1. Determine diet composition to evaluate its effect on genotyping success
2. Complete amplifications with all 9 hypervariable primers to obtain individual fingerprints
3. Evaluate the need for double sampling (mark and re-capture occasions)
4. Estimate otter population size and density in KEFJ and PWS
5. Assess the relation between latrine density and fecal deposition rate to otter density